Analyzing and Interpreting Data on Processes, Outcomes and Costs

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Webinar Details

- This webinar presentation has been pre-recorded

- A live question-and-answer session will be held at the conclusion of the presentation

- Questions may be submitted via the "Question" pod

- Audio for this presentation will be provided through Adobe Connect; there is no separate dial-in

- Closed captioning is not available for this event

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Continuing Education Details

- Continuing education credit is not available for this event

- Sources for materials and additional training information:

  - Materials from this series are available at:

    dcoe.mil/About_DCoE/Program_Evaluation.aspx

  - For information on other DCoE webinar and training series, visit:

    dcoe.mil/Training/Monthly_Webinars.aspx

  - Materials for this webinar are available in the Files box

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Presenters

CAPT Armen Thoumaian, Ph.D.
U.S. Public Health Service
Health Science Officer
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CAPT Armen Thoumaian is a scientist director in the Commissioned Corps of the U.S. Public Health Service with more than 30 years experience in health and mental health program design and evaluation.

In January 2012, CAPT Thoumaian joined the staff at the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE) to help design and implement program evaluation and improvement efforts in the Defense Department.

He holds a B.A. in Psychology and Sociology, an M.A. in General Experimental Psychology, and a Ph.D. in Social Welfare and Social Work, completing an National Institute of Mental Health fellowship in Community Mental Health.

USPHS CAPT Armen Thoumaian, Ph.D**.**

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Presenters

Aaron Sawyer, Ph.D.
Research Scientist, Contract Support for DCoE

Dr. Aaron Sawyer is a clinical psychologist with extensive expertise in intervention outcome research and program evaluation. He has delivered child, family and adult interventions for more than a decade, including specialization in trauma and experience working with military families. Dr. Sawyer holds an M.S. in Experimental Psychology and a Ph.D. in Clinical Psychology. He completed post-doctoral training at The Kennedy Krieger Institute/Johns Hopkins University and is a licensed psychologist.

Dr. Aaron Sawyer

Patrick High, Dr. P.H.
Epidemiologist, Contract Support for DCoE

Dr. Patrick High is an epidemiologist with over a decade of experience and has expertise in survey design, research methodology and program evaluation. His experience includes supporting the Office of the Undersecretary of Defense for Personnel and Readiness, Operations Research and Safety, and the Defense Suicide Prevention Office as an epidemiologist. Dr. High holds the degree of doctor of public health with specialization in Epidemiology and Biostatistics from the Uniformed Services University of the Health Sciences. He previously spent nine years in the Illinois Army National Guard.

Dr. Patrick High

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Presenter/Moderator

Camille Hinds, Ph.D.,
Applied Economist, Contract Support for DCoE

Dr. Camille Hinds holds a doctorate in economics from American University specializing in advanced statistical analysis, econometric modeling and economic evaluation. Her technical expertise has been applied to home mortgage defaults, obesity outcomes, food program participation and military programs. She is an expert in analyzing complex data sets and large national surveys as well as developing survey instruments. She has also taught numerous courses in economics and statistics and has over seven years consulting and government contracting experience.

Dr. Camille Hinds

Debra Stark, MBA,
Research Scientist, Contract Support for DCoE

Ms. Debra Stark is a survey methodologist with 15-plus years of research experience. Her work includes program evaluation and monitoring, qualitative data analysis and survey instrument design. She has worked on public health services evaluation projects with various federal agencies, including the Department of Veterans Affairs and TRICARE Management Activity. Ms. Stark received an M.B.A. from Vanderbilt University

Ms. Debra Stark

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Overview and Objectives

This training presentation will provide guidance on analyzing and interpreting program data on processes and outcomes. It also will provide an overview of strategies used to analyze program costs.

At the conclusion of this webinar, participants will be able to:

- Explain general strategies and key concepts relevant to analyzing program data on processes and outcomes

- Demonstrate basic knowledge of economic analysis strategies relevant to program data

- Implement suggested guidance to initiate analysis and interpretation of program data

- Identify common challenges that programs face in analyzing and interpreting data and resources for technical support

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Agenda

- Introduction
- Process Analyses
- Outcome Analyses
- Analyzing Program Costs
- Common Challenges
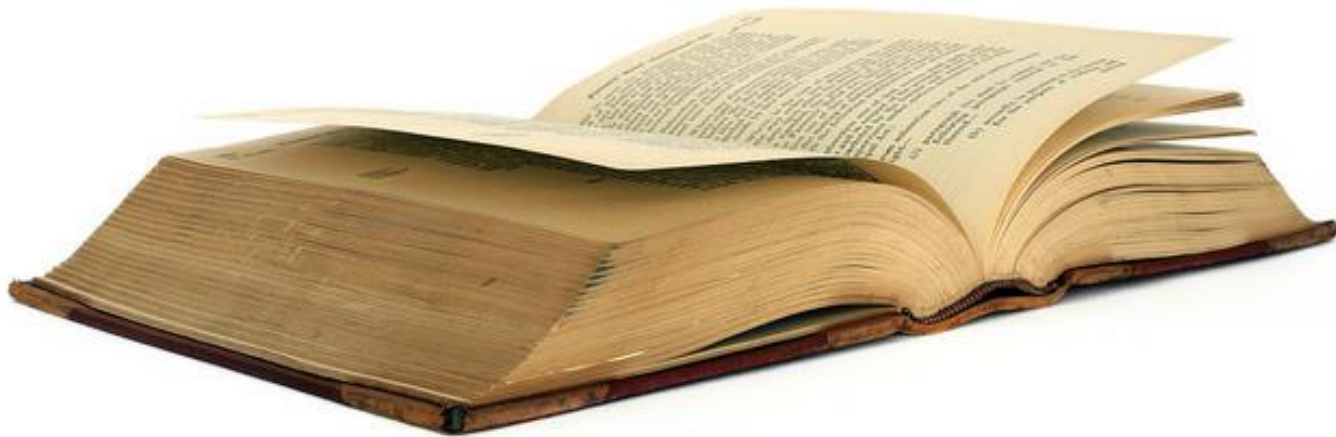- Conclusion
- Resources
- Feedback and Q&A Session

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Introduction

What Do the Data Have to Say?

"Numbers have an important story to tell. They rely on you to give them a voice."

-Stephen Few

Image Source: Brenda Clarke

# What Is Data Analysis, and Why Is It Important?

- Analysis will help you summarize important evaluation information and help you present information to your stakeholders

- Unless you measure and analyze data, there is no way to tell whether a program is working

- Data analysis refers to methods used to describe information, detect patterns, develop explanations and test hypotheses
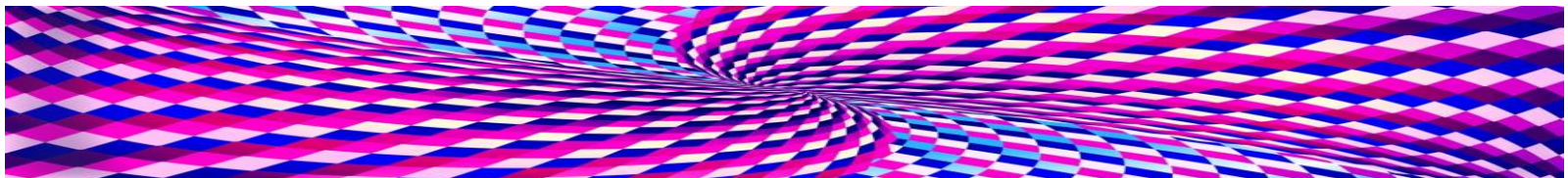
Prepare Data for Analysis

To begin, organize data and compare response to ensure the data are ready for the next step in analysis:

- Develop standard operating procedures (SOPs) for "missing" or "not applicable" responses

- Tabulate data on a question-by-question basis

- Recode data
  - Ensure data have the same meaning
  - Address "small cell" issue (< 5 per cell)

- Look at summary responses for each item

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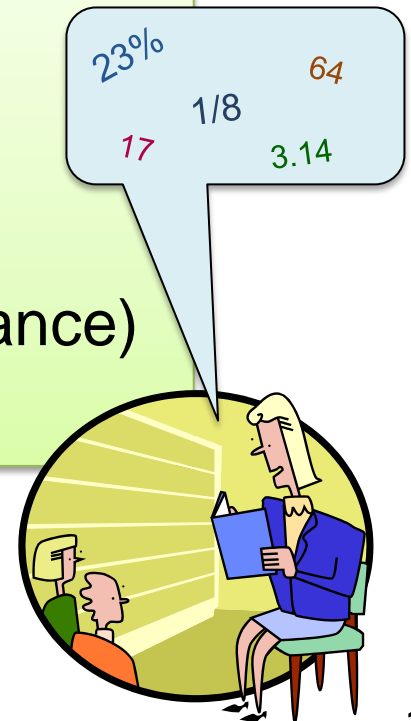For Psychological Health & Traumatic Brain Injury
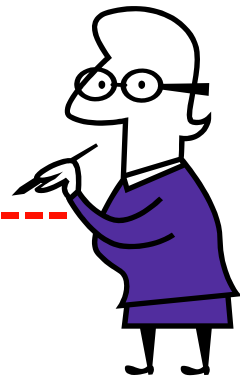
Every Dataset Tells a Story

Understand your data. Use descriptive statistics to examine how one variable relates to another

Describe the Data

- Counts (frequencies, percentages)
- Central tendency (mean, median, mode)
- Variability (range, standard deviation, variance)

23%   64
1/8
17   3.14

Counts (Frequencies)

- Sometimes a count is all that is needed
- Counts often serve as the basis for other calculations, such as for percentages

Percentages: Play by the Rules

- Use the correct denominator
- Round percentages to the fewest decimals needed (17.6 versus 17.5714)
- Add percentages only when categories are mutually exclusive
- Do not add percentages to obtain an average percentage across groups
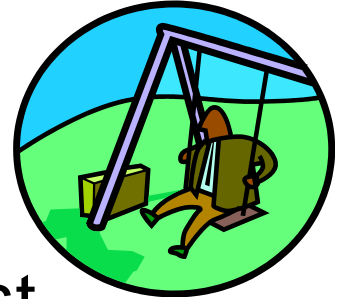
Central Tendency: Mean, Median, Mode

Understand what is **typical** for your participants

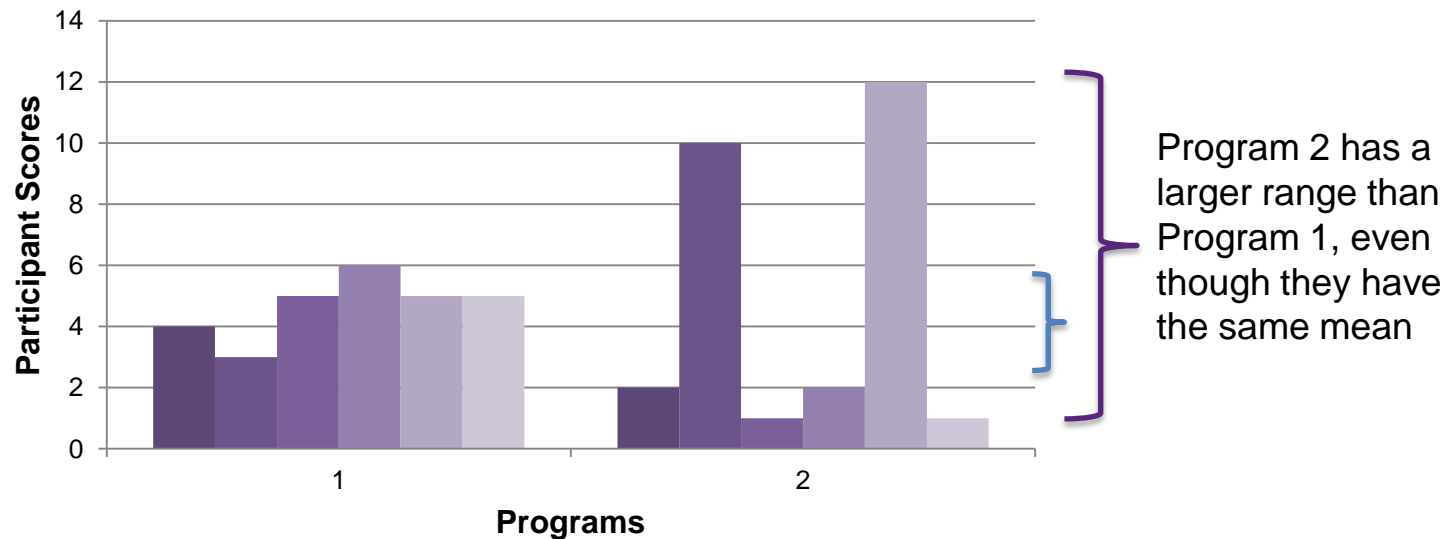**Mean** = the average; sum of all answers or scores divided by the total number of participants

Median = the middle value or mid-point; half of the values are above and half fall below

Mode = the most commonly occurring value

Variability: Range

Understand how much your data **differ**
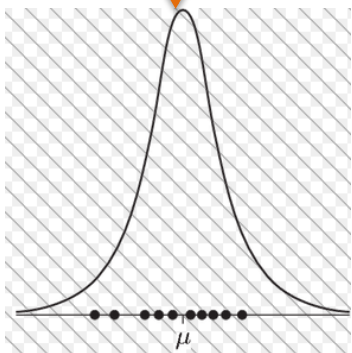

Program 2 has a larger range than Program 1, even though they have the same mean

A range provides the difference between the lowest and highest scores

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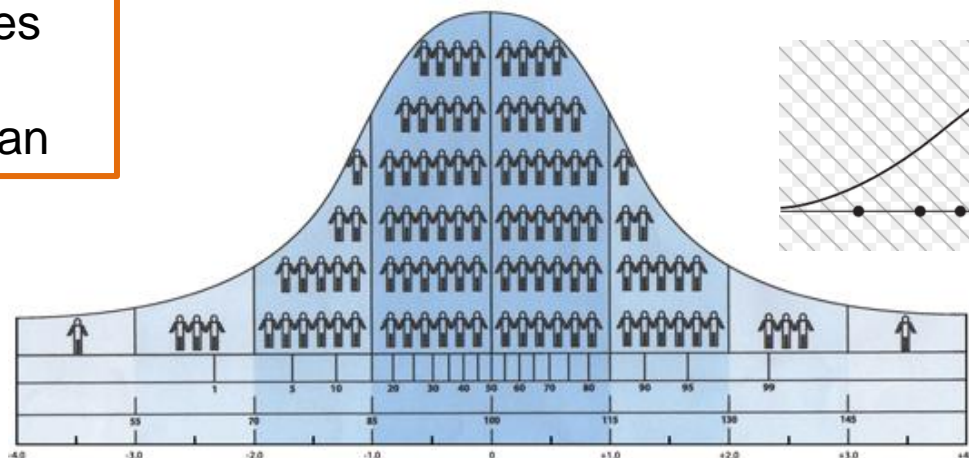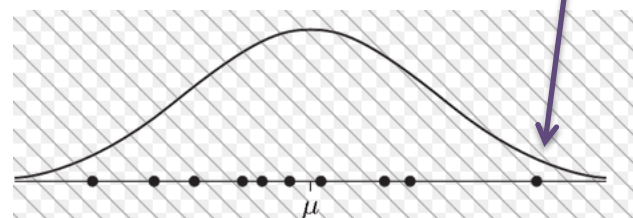For Psychological Health & Traumatic Brain Injury

Variability: Standard Deviation

Standard deviation (SD) is the degree to which individual values vary from the mean. It is the average distance that scores lie from the mean

A high SD means responses vary greatly from the mean

A low SD indicates responses are similar to the mean

Normal Distribution

Image sources: http://www.home-speech-home.com/speech-therapy-resources.html
http://sysmic.ac.uk/textbook/3.4-introducing-confidence-intervals.html

Descriptive Statistics

Inspection of data through descriptive statistics will help to:

- Determine the most appropriate evaluation questions
- Identify data entry errors, incomplete data or outliers
- Determine whether statistical assumptions are met (e.g., normal distribution)
- Influence the type of inferential analyses to be performed

Examine Patterns in the Data
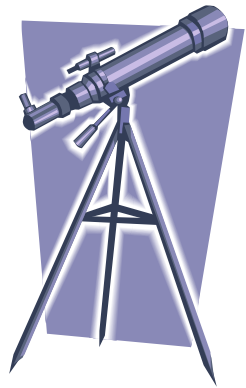
- Create charts, tables, lists and graphs
- View the findings from different perspectives
- Create crosstabs
- Highlight significant findings

Inferential Statistics

Inferential statistics are about whether a change or outcome is meaningful, significant, and whether the change is specifically related to program activities

They enable one to generalize or infer sample findings to larger populations, or to assess the probability of certain findings

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Comparison Groups

Comparison groups may be used to establish that participant changes were the result of your program's intervention and not some other factor

In the best case scenario, members of comparison groups are similar to your participants in every way except for program participation
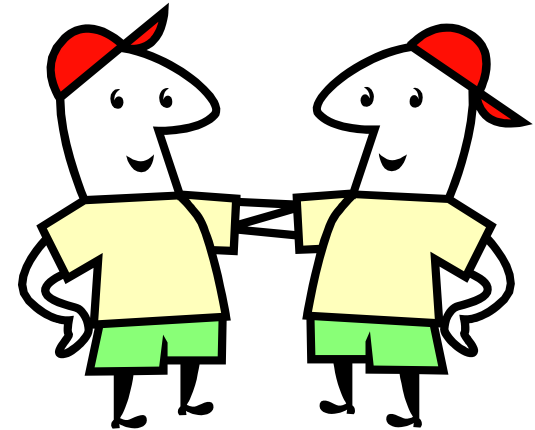
Statistical procedures can be used to compare groups with respect to age, gender, race, ethnicity and other characteristics

Inputs Required for Data Analysis

- Training in administration of the metric
- Spreadsheet or database
- Training for data entry
- Data analysis software (e.g., Excel, SPSS, Stata, SAS, R)
- Personnel to conduct analyses
- Funding
- Time

Process Analyses

Process Questions

Core Question:

- Was the program implemented with fidelity?

Other Questions of Interest:

- How does the program operate?

- What is the program expected to achieve?

- How is the program expected to achieve what it has set out to achieve?

- How did participants perceive the program?
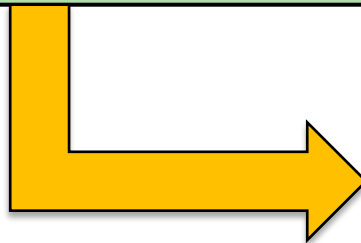
How do these processes affect program outcomes?

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Components of Process Analyses

- Resources (e.g., facilities, staffing, space)
- Barriers (e.g., inadequate funding, space, training or staff numbers)
- Services/activities (e.g., clinical, outreach, education, research)
- Exposure (e.g., population exposed to program, recruitment/retention strategy)
- Context (e.g., environment)

Was the Program Implemented with Fidelity?

Metrics	Implementation	Currently	Degree of Change
Coverage	What percent of the target population was covered by the program?	What percent of the target population is currently being covered by the program?	Has coverage increased, decreased or remained unchanged? Why?
Content	What activities were conducted?	What activities are currently being conducted?	Are the same activities being conducted that were implemented?
Frequency	How frequently were activities being conducted at implementation?	How frequently are activities currently being conducted?	Has the frequency of each activity remained the same or changed over time?
Duration	What was the duration of each activity at program implementation?	What is the duration of each activity currently?	Has the duration of each activity remained the same or changed over time?

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Example Process Metrics

Tracking Process:

- **Participation** – calls to helpline, session attendance, target population, participant demographics, participant referral source

- **Program Satisfaction** – satisfaction ratings, likelihood of referring others to the program

- **Activities** – frequency and length of each activity, number and type of each activity, number of sessions held, number of referrals made

Note: For items in red, examples are provided in the slides that follow

Process Metrics:
Non-Clinical Program Example

Coverage and Participant Demographics

Demographics	Target Population Number (N)	Participant Population Number (n)	Participant Population Percent (%)
Total	29,694	25,931	87
Branch			
Active Duty	22,959	19,915	87
National Guard	3,481	3,251	93
Reserve	3,254	2,765	85
Sex			
Males	22,271	20,744	93
Females	7,423	5,187	70

Program is reaching only 87% of the target population

Program is reaching only 70% of females

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Participant Satisfaction: Non-Clinical Program Example

How satisfied were program participants with the services offered?

Satisfaction Response Options	Number (n)	Proportion (%)
Extremely	3,890	15
Very	7,779	30
Neither Satisfied or Dissatisfied	1,297	5
Somewhat	5,186	20
Not at all	6,483	25
No response/Missing	1,297	5
Total	25,932	100

Only 45% of program participants were very or extremely satisfied with the services offered.

50% of program participants were not at all, somewhat or neither satisfied or dissatisfied with the services offered.

Low number of non-responses does not present a concern.

Perceived Usefulness: Non-Clinical Example

How did participants perceive the usefulness of the training session?

Perception	Number (n)	Proportion (%)
Extremely	5	3
Very	50	31
Somewhat	80	50
Not at all	20	13
No response/Missing	5	3
Total	160	100

Combining these two categories indicates that 1/3 (33%) of program participants found the training session very or extremely useful.

Combining these two categories indicates that nearly 2/3 (63%) of program participants found the training somewhat to not at all useful.

Frequency of Program Activities Over Time: Clinical Program Example

Activity	Implementation	Currently	Was there a change?	Reason(s) for change
Psychological health screening	Every visit	Initial visit & every 60 days	Yes	Scientific evidence
Outreach	3 times per week	3 times per week	No	N/A
Resilience Education	Every visit	Every visit	No	N/A
Research	None	Annually	Yes	Compare participant outcomes to baseline

Program started comparing participant outcomes to baseline scores to determine effectiveness

No changes occurred from implementation to currently therefore providing a reason is not applicable.

Program changed the frequency of their program activity because of scientific updates
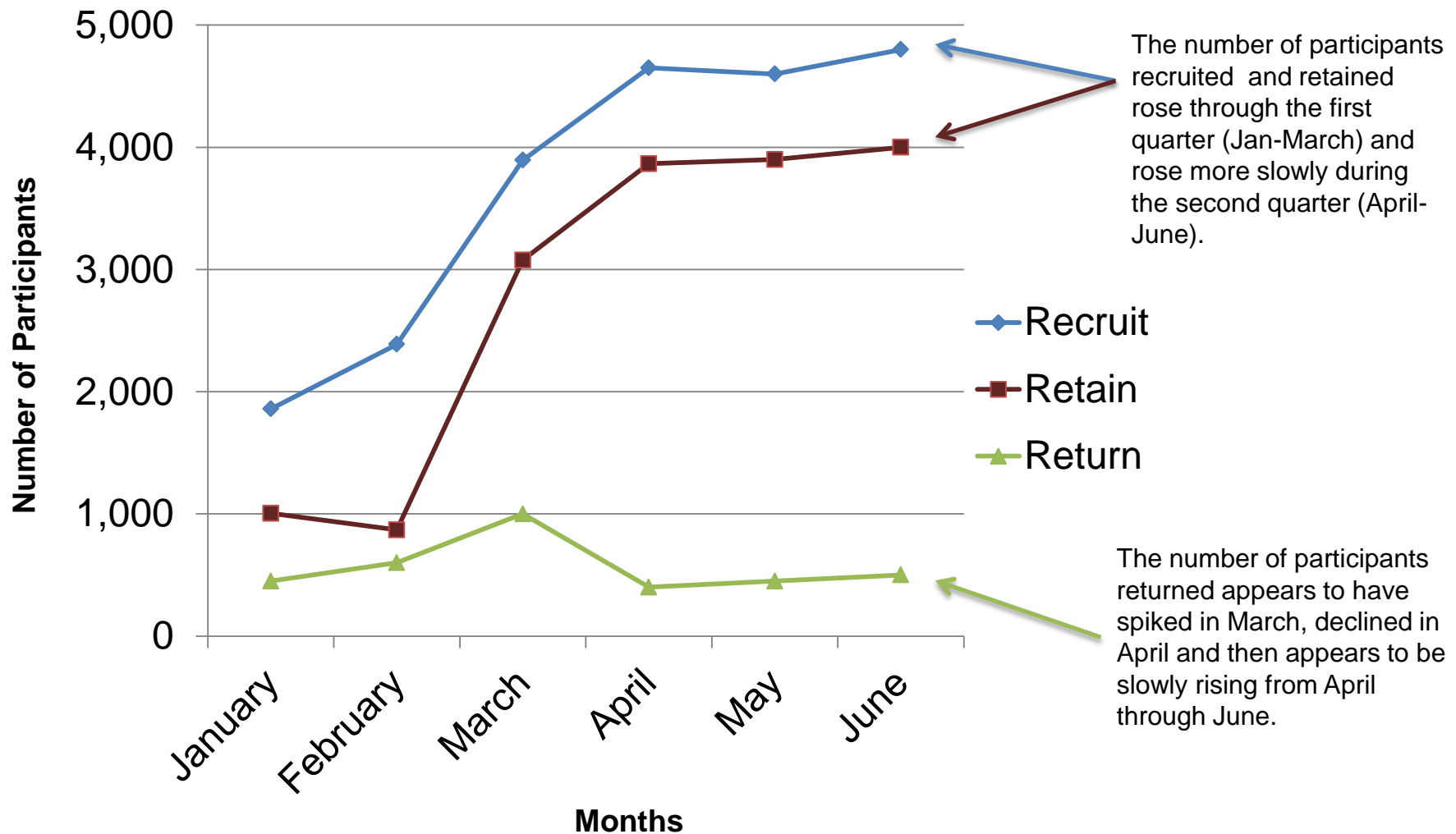
Duration of Program Activities Over Time: Non-Clinical Program Example

Activity	Implementation	Currently	Change?	Reason(s) for change
Resilience screening	15 minutes	5 minutes	Yes	Reduced number of professional staff
Outreach	1 hour	1 hour	No	N/A
Resilience education	1 hour presentation	45-minute webinar	Yes	Reduced number of staff

The duration of resiliency screening and education activities decreased from program implementation to the present. Additionally, the mode of delivery changed for the educational component from a presentation to a webinar.

The changes to the program are because the program has fewer staff than when the program was implemented. Thus, the amount of time spent on activities has been reduced.

Recruitment, Retention and Return of Program Participants

The number of participants recruited and retained rose through the first quarter (Jan-March) and rose more slowly during the second quarter (April-June).

The number of participants returned appears to have spiked in March, declined in April and then appears to be slowly rising from April through June.

Connecting Processes to Outcomes

- Determines extent to which outcomes may be affected

- Fidelity has impact on program success

- Moderates intervention and program outcomes

- Prevents false conclusions about program effectiveness

PROCESSES ⊂⊃ OUTCOMES

Outcome Analyses

Use Outcome Evaluation Questions to Guide Program Improvements

Core Question:

- Did the program achieve its intended outcomes?

**Other Questions of Interest:**

- Did outcomes vary by sub-population or intervention group?

- Did any unexpected positive effects occur as a result of program activities?

- Were there any unintended negative outcomes?
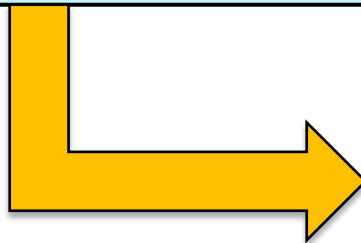
What should be improved or changed in the program?

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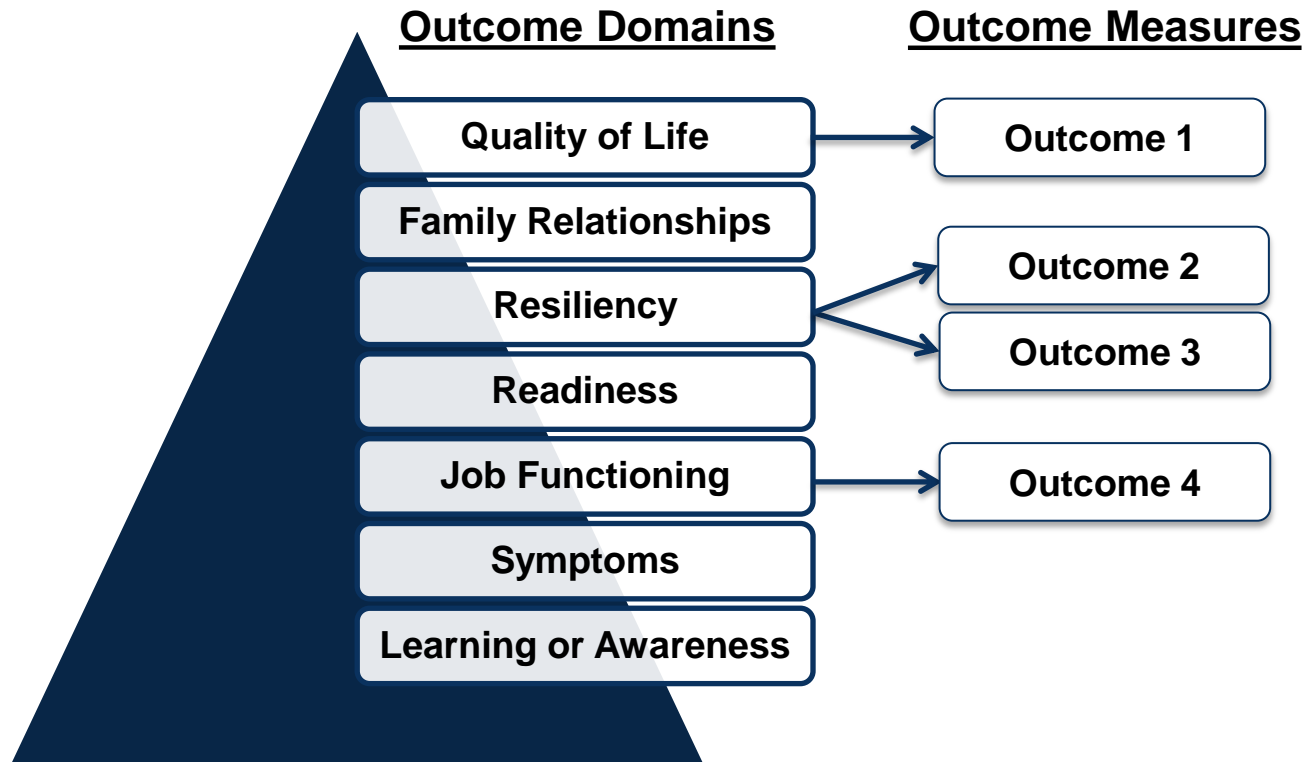
Begin by Describing Outcome Data

Examine descriptive statistics, such as response frequency, group averages and variability to learn about the characteristics of outcome data
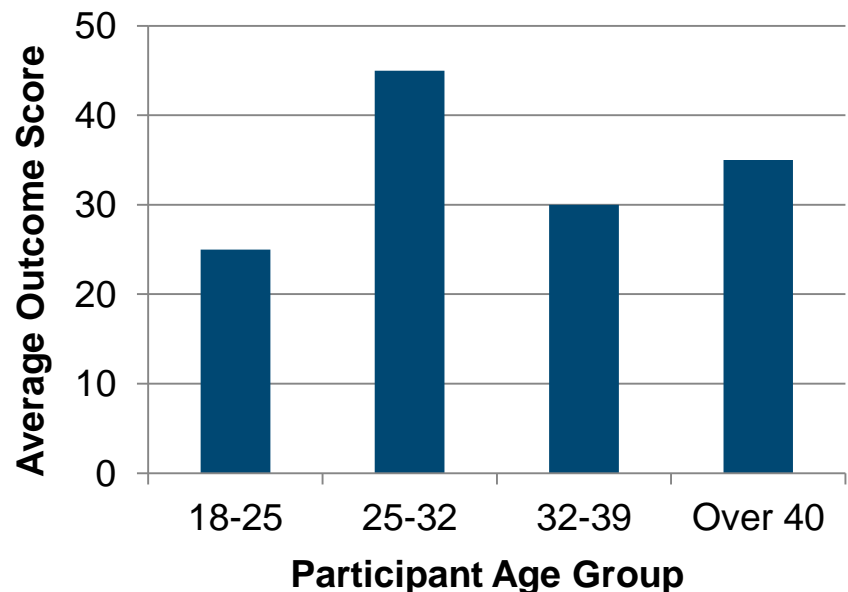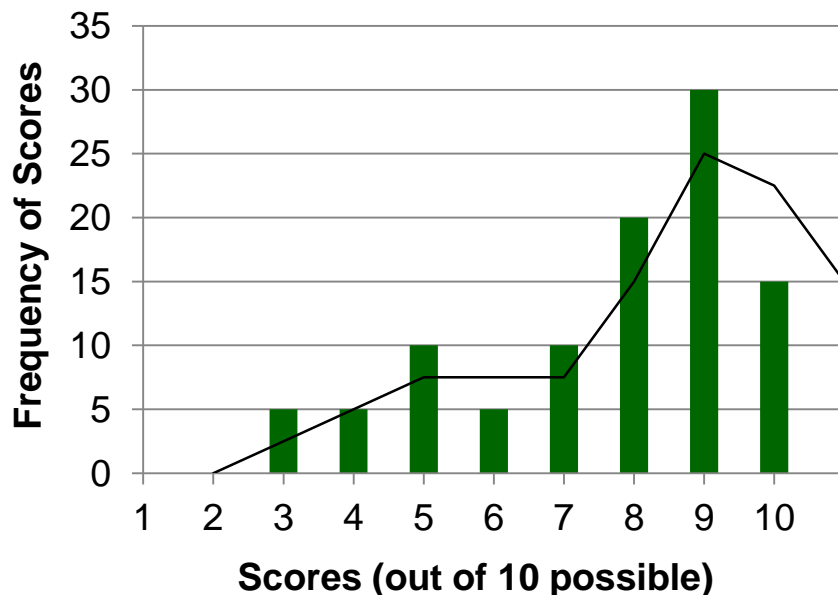
Conduct Analyses to Address Key Outcome Evaluation Questions

Core Question for Outcome Evaluations:

Did the program achieve its intended outcomes?

Compare Measured Outcomes to Stated Objectives

To determine whether desired outcomes are achieved, it is necessary to:

1. Start with SMART objectives (Specific, Measurable, Achievable, Relevant, Time-Bound)

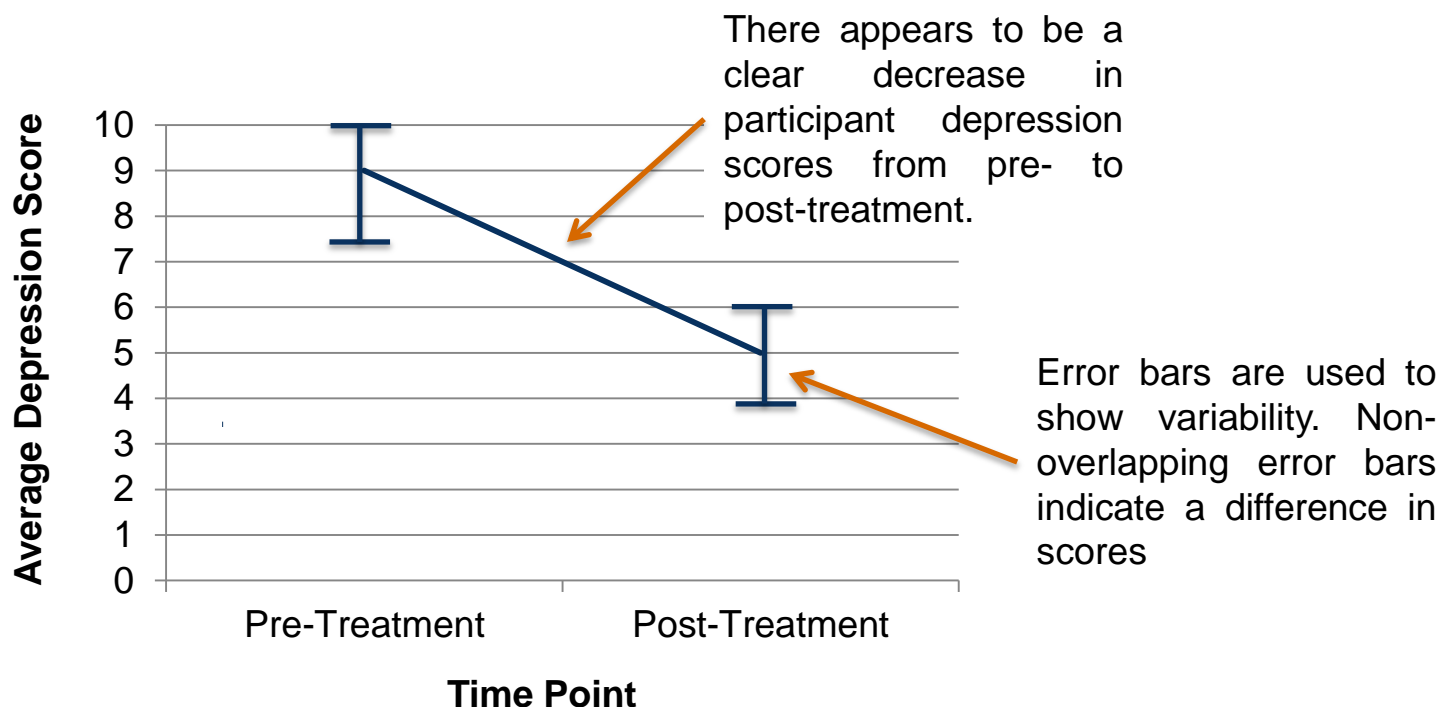2. Directly compare measured outcomes to stated objectives

MEASURED OUTCOMES = STATED OBJECTIVES ?

Compare Measured Outcomes to Stated Objectives: Clinical Example

Objective: Program participants will exhibit reduced depression symptoms from pre- to post-treatment

Measured Outcome: On average, depression scores decreased from 9 to 5

There appears to be a clear decrease in participant depression scores from pre- to post-treatment.

Error bars are used to show variability. Non-overlapping error bars indicate a difference in scores

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Compare Measured Outcomes to Stated Objectives: Non-Clinical Example

Objective: Program participants will demonstrate improved resilience from baseline to post-program and will be maintained as 6-month follow-up
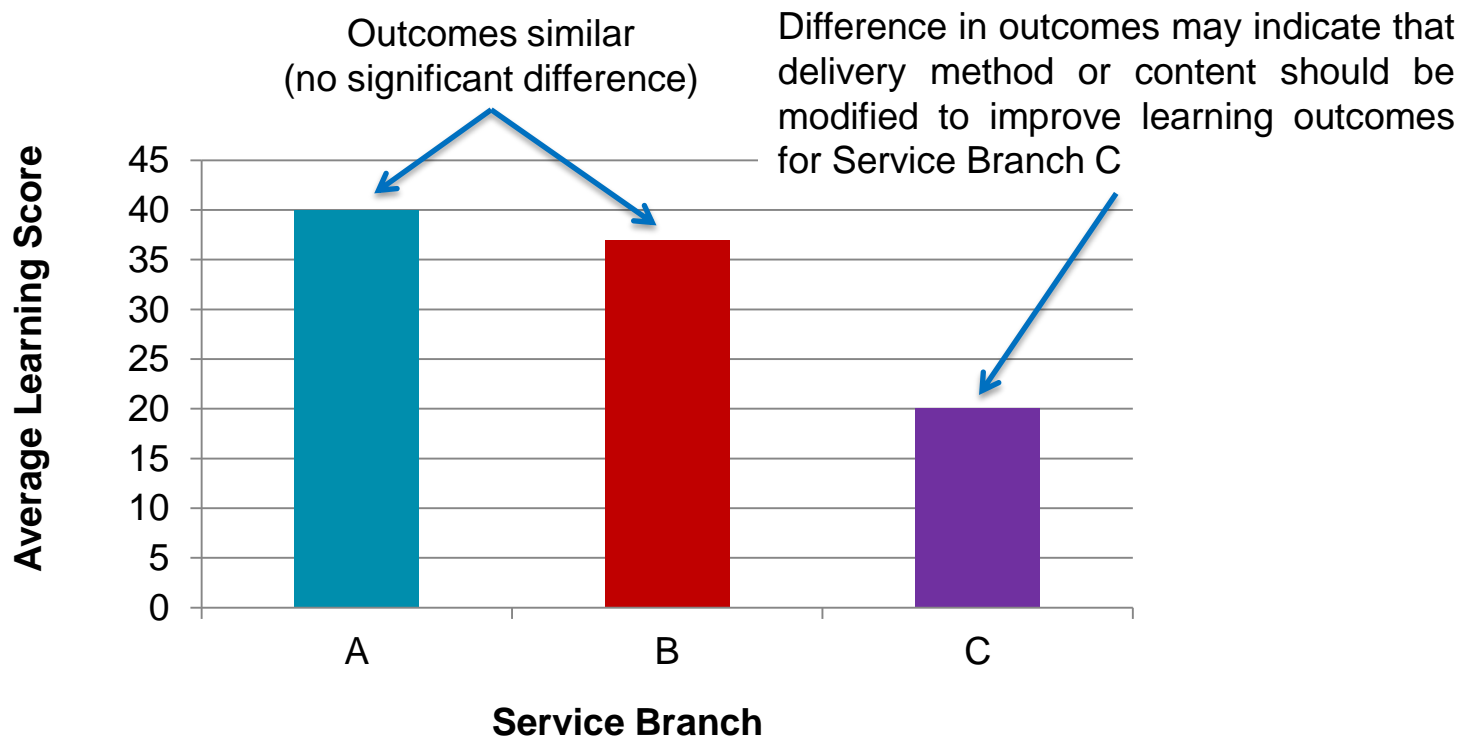
Measured Outcome: On average, resilience ratings increased from 15 to 30, but then declined to 20

Initial benefit is evident from pre- to post-program participation.
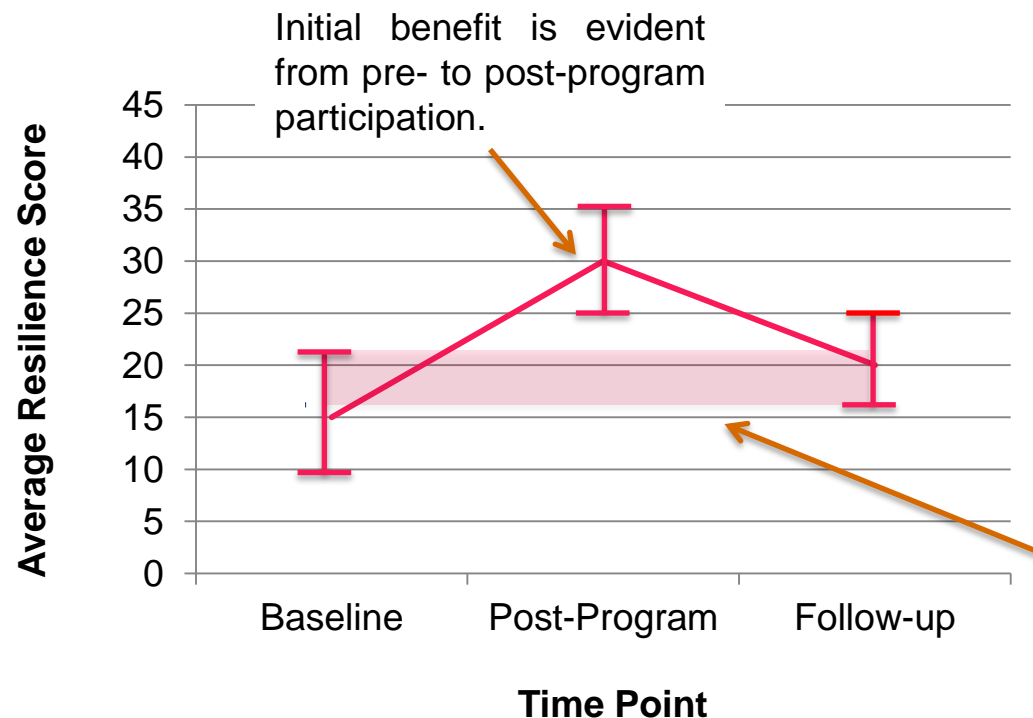
Overlap in error bars at baseline and follow-up indicates that benefit is not sustained over time.

Average Resilience Score vs. Time Point (Baseline, Post-Program, Follow-up)

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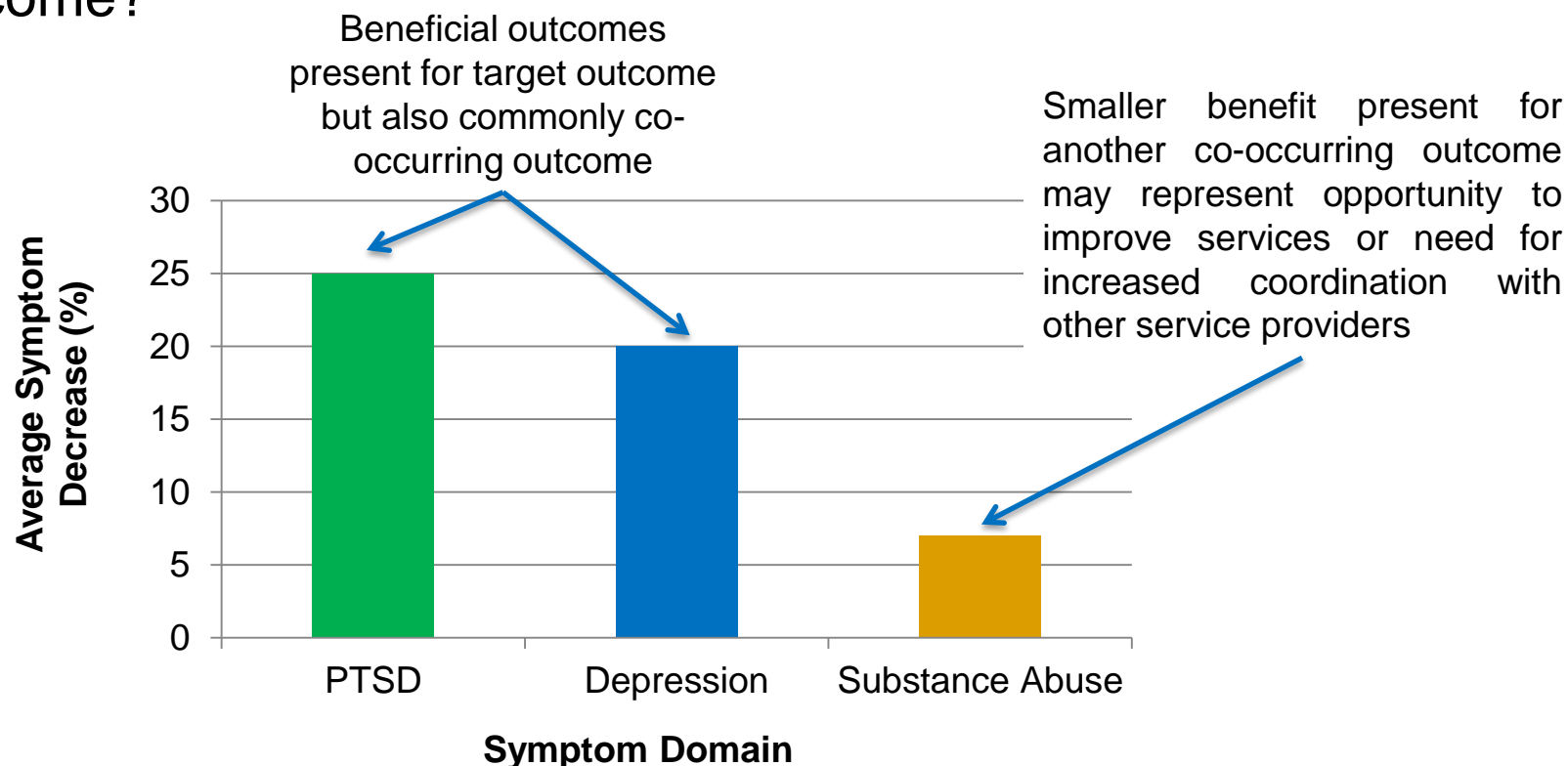For Psychological Health & Traumatic Brain Injury

Use Outcome Evaluation Questions to Guide Program Improvements: Non-Clinical Example

Consider a non-clinical program focused on increasing learning among personnel from different service branches. What does it mean if outcomes vary by sub-population?

Outcomes similar (no significant difference)

Difference in outcomes may indicate that delivery method or content should be modified to improve learning outcomes for Service Branch C

Bar chart: Average Learning Score by Service Branch — A ≈ 40, B ≈ 37, C ≈ 20

Use Outcome Evaluation Questions to Guide Program Improvements: Clinical Example

Consider a clinical program focused on decreasing post-traumatic stress disorder (PTSD) symptoms. What does it mean if effects are or are not present for outcomes other than target outcome?

Beneficial outcomes present for target outcome but also commonly co-occurring outcome

Smaller benefit present for another co-occurring outcome may represent opportunity to improve services or need for increased coordination with other service providers

Average Symptom Decrease (%)

Symptom Domain

PTSD — Depression — Substance Abuse

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Summarize Outcomes for Stakeholders

An effective summary of outcomes for stakeholders will convey information about:

- Whether intended outcomes were achieved and how program administrators know they were achieved
- Target outcomes as well as other outcomes of interest to stakeholders (e.g., readiness)
- Areas of strength and areas in which improvements could be made
- Planned changes to improve outcomes and program quality in the future
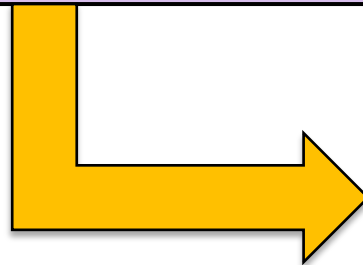
Analyzing Program Costs

Use Cost Analyses to Guide More Effective Use of Resources

Core Questions:

- Which is the most effective intervention to fund?

- How are program funds being spent?

Other Questions of Interest:

- What types of analyses use cost measures?

- How are costs quantified?

- What are the average cost values per participant?

How can resources be used more effectively?

Why Analyze Program Costs?

- Resources are scarce and stakeholders have to choose among viable alternatives. Analyzing program costs provides stakeholders with an objective measure to help make informed decisions about funding

- Often the "best" choice is not obvious because interventions differ on many dimensions (e.g., services delivered, population addressed, outcomes metrics used)

- Cost estimates help program administrators track how budgets are allocated across activities, and how well the program is functioning relative to its target goals and operating budget

Program A
Program H   Program B
Program G   Program C
Program F   Program D
Program E
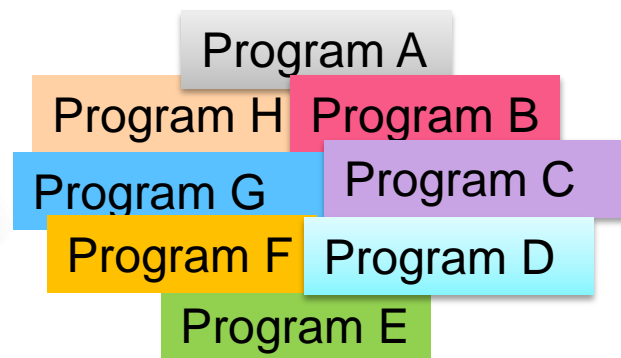
What Does "Cost" Mean?

- Cost refers to the value of resources used to deliver services

- Relevant resource categories include:
  - Labor
  - Contracted services
  - Building and facilities
  - Materials and supplies
  - Donated resources

- For contracted resources, quantify costs using actual expenditures rather than budget line items because budgets may not reflect the amount of monies actually spent

- For donated resources, costs can be quantified as the expenditure that would have been incurred had the resource not been donated

Cost-Effectiveness Analysis

- A type of economic evaluation that examines the costs and outcomes of alternative intervention strategies

- Cost-effectiveness analysis (CEA) summarizes the value of a program into a single measure that reports cost per unit of health benefit

$$\frac{Cost_{PROGRAM\ B} - Cost_{PROGRAM\ A}}{Outcome_{PROGRAM\ B} - Outcome_{PROGRAM\ A}}$$

Cost-Utility Analysis

Cost-utility analysis (CUA) is a special case of CEA in which program benefits are expressed in terms of a specific outcome measure: quality-adjusted life years (QALYs)

$$\frac{Cost_{PROGRAM\ B} - Cost_{PROGRAM\ A}}{QALY_{PROGRAM\ B} - QALY_{PROGRAM\ A}}$$

QALYs represent a measure of the value a person places on life lived in good health

Source: DVIDS

Cost-Benefit Analysis

- A technique that expresses the program's costs and benefits entirely in dollar terms

- Cost-benefit analysis (CBA) is more complicated to apply to mental health care than CEA because it requires attaching dollar values to outcomes that are not directly measured in dollars (e.g., sense of community, depression)

Summary: Types of Cost Analysis

Type of Analysis	Cost Measure	Outcome Measure
Cost-Effectiveness Analysis (CEA)	$	Nonmonetary units -life years gained -increased resilience -reduced depression -increased learning
Cost-Utility Analysis (CUA)	$	Quality-Adjusted Life Years (QALYs)
Cost-Benefit Analysis (CBA)	$	$

Determining Program Costs

Collecting good cost data is at the heart of every useful cost analysis

Steps to quantify program cost information:
- List the main activities the program performs
- List the resource categories used to support each program activity
- Assess the data available from existing sources such as time sheets, payroll accounts, bills and contracts
- Collect and document the activity costs on a worksheet
- Compute average cost values

Knowing the cost of each activity helps answer questions about the total cost of the program **and** the costs of specific activities

Sample Cost Worksheet

Total Program Costs

Example Program: Military Resiliency Training
Begin Date: 10/01/2013
End Date: 3/31/2014

COST COMPONENT	SCREENING	EDUCATION	INTERVENTION	OVERSIGHT/ ADMINISTRATION	TOTAL COST
Noncontract Labor	$12,175	$17,350	$59,870	$80,360	$169,755
Contracted Services	$1,500	$52,570	$12,750	$4,250	$71,070
Materials and Supplies	$1,250	$15,980	$4,950	$23,090	$45,270
Building and Facility	$8,325	$27,000	$30,000	$70,000	$135,325
Donated Resources	$2,500	$20,000	$16,030	$18,290	$56,820
TOTAL COSTS	$25,750	$132,900	$123,600	$195,990	$478,240

Cost Per Participant

Average Program Costs

Example Program: Military Resiliency Training
Begin Date: 10/01/2013
End Date: 03/31/2014
Number of Participants: 1,000

	SCREENING	EDUCATION	INTERVENTION	OVERSIGHT/ ADMINISTRATION	TOTAL
TOTAL COST	$25,750	$132,900	$123,600	$195,990	$478,240
PARTICIPANTS	1,000	1,000	1,000	1,000	1,000
COST PER PARTICIPANT	$25.75	$132.90	$123.60	$195.99	$478.24

Once cost values have been recorded, it is a straightforward exercise to compute average values by participant for each key activity and overall

Special Considerations for Conducting Analyses of Military Programs

- It may be difficult to obtain program records for older programs

- A program may change substantially over time and operate as a fundamentally different program from when it began

- It is important to capture data on outcomes of interest to both stakeholders and program personnel

- Determining program impact requires that a program exist long enough to capture outcomes of importance to stakeholders

- Some costs may be difficult to determine due to multiple funding streams or complex procedures for obtaining budgetary information

Source: California National Guard

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Common Challenges FAQ

- How can I assess program fidelity when I have limited information from program initiation?

- What are some effective ways to address attrition with regard to validity of a program's outcome data?

- How do I conduct analyses for a program that has many separate but interrelated components?

- What should I do if I am unable to obtain information about all of the financial aspects of my program?

How Can I Assess Program Fidelity When I Have Limited Information From Program Initiation?

- Some information may be available from historical records, former program personnel or service-level databases

- It may be necessary to re-initiate a program with updated mission, goals and objectives to serve as a baseline for future evaluations

  - Revisit the evidence basis for the program, because more up-to-date information about effective practices may be available

  - Also revisit the need for the program and population served, which are likely to have changed over time

What Are Some Effective Ways to Address Attrition With Regard to Validity of a Program's Outcome Data?

- Determine when the attrition was first noted (e.g., conclusion of program vs. currently collecting data)

- If at the conclusion of a program, specific statistical techniques will need to be applied

- If during data collection, consider:
  - When is attrition occurring (i.e., non-completion of certain activities vs. unavailability for follow-up following program completion)
  - Cause of attrition (e.g., death, inability to locate or other/unknown reason)
  - If participants lost to follow-up similar to those that completed the program

How Do I Conduct Analyses for a Program That Has Many Separate but Interrelated Components?

- It is important to measure processes and outcomes in as much detail and as accurately as possible

- Specific analyses will depend upon the goals of the evaluation process
  - It may be beneficial to examine whether specific components are associated with specific outcomes, based on the program's logic model

  - Likewise, it will be beneficial to examine whether specific program components are implemented with fidelity

- Broader analyses of processes or objectives are often useful in conveying the value of the program as a whole

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What Should I Do if I Am Unable to Obtain Information About All of the Financial Aspects of My Program?

- Collecting accurate, highly detailed information can be burdensome:
    - Seek to collect the most accurate and precise data needed to answer evaluation questions (e.g., daily)
    - However, favor precision over accuracy in collecting cost data to ensure that the results can be reproduced (e.g., weekly)

- Donated resources (e.g., labor provided by military members and civilian employees) not reflected in a program's budget or expenditures may be estimated using salary averages derived from published pay scales

Conclusion

Key Takeaways

✪ Programs can use data analysis strategies to provide evidence of a program's effectiveness

✪ Data analysis can also be used to establish the degree to which a program's inputs and outputs contribute to its outcomes

✪ Analyses of program processes, outcomes and costs can guide program improvements

Photo by: Stewart Leiwakabessy

Resources

DCoE Program Evaluation Guide:
www.dcoe.mil/Content/Navigation/Documents/DCoE_Program_Evaluation_Guide.pdf

Agency for Healthcare Research and Quality:
www.qualitymeasures.ahrq.gov

National Quality Forum:
www.qualityforum.org/Measures_Reports_Tools.aspx

Deployment Health Clinical Center:
www.pdhealth.mil/clinicians/assessment_tools.asp

Defense and Veterans Brain Injury Center:
http://dvbic.dcoe.mil/diagnosis-assessment?audience[0]=3

National Center for Telehealth and Technology:
www.t2.health.mil

Centers for Disease Control and Prevention:
http://www.cdc.gov/healthyyouth/evaluation/data.htm
http://www.cdc.gov/owcd/eet/CostEffect2/1.html

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Resources (continued)

National Network of Libraries of Medicine:

http://nnlm.gov/evaluation/guides.html

Pell Institute:

http://toolkit.pellinstitute.org/evaluation-guide/

The Community Tool Box:

http://ctb.ku.edu/en

University of Wisconsin-Extension:

www.uwex.edu/ces/pdande/

Minnesota Department of Health:

www.health.state.mn.us/divs/opi/qi/toolbox

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